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NETWORK CODING TECHNIQUE FOR RELIABLITY IN WBAN - A SIMULATION APPROACH

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ABSTRACT

Wireless body area networks for ambulatory monitoring and health care is an active area of applied research. Reliability of wireless body area networks for patient monitoring is very important since they deal with human life. Reported applications have had performance and reliability problems. Use of a WBAN also provides health monitoring of patient's vital signs with real time updates of medical records via internet provides economical solutions to health care system. For such a system it is very important that a WBAN can collect and transmit data reliably, and in a timely manner. In this paper, several reported applications of wireless body area networks are reviewed and the reliability of a WBAN is computed. we examine the performance evaluation of WBAN using A Demodulate and Forward Exclusive OR Network Coding Scheme to generate an efficient network code to increase the reliability while keeping delay low during communication using network route quality identifier and next hop identifier. We study the performance of a remote patient monitoring system using NS2 simulation model.

KEYWORDS: Demodulate and Forward XOR Network Coding, Next Hop Identifier, Reliability, Route Quality Identifier, WBAN

INTRODUCTION

WBAN

A Wireless body area networks (WBAN) for patient monitoring system requires the multiple sensor nodes. WBAN suggest promising technology with the prospective to transfigure health care by allowing inconspicuous health monitoring. A typical WBAN consists of a number of inexpensive, inconsequential and tiny sensor called node. Each node is typically competent of sensing physiological signals such as Blood pressure, ECG (Electro Cardio Gram), electromyographs (EMGs), and/or electroencephalographs (EEGs), SpO_2, Pulse Oximeter and Temperature etc., Processing these signals and storing the process data and transmitting to sink nodes. The data gathered by sink node, which can process and upload the result on BAN server through Home server with local area network or internet. WBANs form ambulant patient monitoring system. In wireless communication more trace on increasing high data throughput, very low power, short distances and low cost. BAN is proficient of generating large quantities of real-time data, the prospective for information surplus is very high. It is very important that only data which is of significance to the medical practitioners is communicated in a timely manner. In WBAN physical layer, MAC layer and Network layer plays important role to provide true information to medical server. Energy, antennas and radios issues are handled by Physical layer. Data rates are managed by MAC layer, Network layer takes care to find best possible route from source to destination [6][13]

The aim of wireless body area network (WBAN) is to continuously monitoring a patient's health condition and transfer it over a long-distance communication network and maintain record. This collected data is then stored and present to the doctor for exact status of patient's health condition this will help the patient to get immediate attention in life-threatening situations [3]. Therefore Reliable communication in wireless body area network for health monitoring is required [4] [5][13].

RELATED WORK

Nabil Ali Alrajeh et al [6] have proposed a novel multi-radio multichannel framework for efficient communication among devices in WBAN. The focus of this research is to ensure energy efficient and reliable communication in WBAN. The multi-radio multi-channel offer efficient data delivery rate and reduced end-to-end delay. However, more energy consumption is observed in multi-radio multi-channel mechanism due to operation of extra radios.

Baozhi Chen and Dario Pompili [10] have proposed a novel in-network solution to prioritize the transmission of patient vital signs using wireless body area networks; the solution relies on a distributed priority scheduling strategy based on the current patient condition and on the vital sign end-to-end delay/reliability requirement. The proposed solution was implemented in Tiny OS and its performance was tested in a real scenario. However there occurs delay and error due to loss of data.

Baozhi Chen et al [11] have developed a novel wireless communication solution that seamlessly supports patient mobility and that prioritizes vital signs transmission using Wireless Body Area Networks (WBANs). This solution overcomes the current limitations of patient monitoring in pre- and hospital environments, which represent an important barrier for developing improved trauma triage strategies. However there occurs signal error due to packet loss.

Samaneh Movassaghi et al[10] have proposed a novel cooperative transmission scheme for Wireless Body Area Networks(WBANs The proposed RXNC scheme outperforms the no-cooperation and conventional bitwise network coding schemes in all channels Signal to noise ratios(SNRs) from 0 dB to 18 dB. However there occurs error propagation.

PROPOSED SOLUTION

For monitoring patients vital sign two tier architecture is proposed. Which further requires two protocol stacks 1) Intra-BAN and 2) Inter-BAN. To supports communication between BANs inter-BAN protocol is used, while the intra-BAN protocol takes care of cumulative patient's vital signs. Different modules are suggested for reliable communication i.e. Routing, Medium Access Control (MAC), and Scheduling, to meet the domain-specific requirements; it is observed that available energy is wasted on idle listening. Whereas collisions, protocol overheads and interference occurs at routing medium access and data loss error occurs during data transmission.

Random XOR Network Coding (RXNC) technique is used for data transmission. In this message from each source node is demodulated by each relay. The relay randomly selects d different symbols from the hard-decision symbols of the source nodes, and XORs them to generate each network coded symbol. This network coding scheme has less complexity and reduces error propagation at the relay nodes. [14][15]

Coding Proposal

This section describes about network coding scheme based on demodulate and forward along with XOR operation for reliability and the routing Model. [14][15]

Direction-Finding Model

In [10], they have proposed direction finding estimated Route Quality Identifier (RQI) and Link quality Identifier (LQI) as shown in Figure 1. When a node want to route traffic to the sink, then it selects next hop based on best RQI in the routing table to generate network coded symbol. But they have not considered any interference free or reliable communication for patient monitoring in WBAN. Hence we propose an interference free reliable communication for patient monitoring by applying DXNC which is described in the following section. In Figure 1 the link with maximum RQI is selected that (1-9-2-3-Sink) where each coded symbol is connected with 2 decided relay to increase the reliability for the communication.[14][15}

In Figure 2 DXNC scheme is described through bipartite graph. In this scheme coded symbols from each source is considered as a variable node and each decided symbol at the relay is considered as check node. As shown in Figure 2 each coded symbols is correctly connected 2 decided symbols.[14][15]

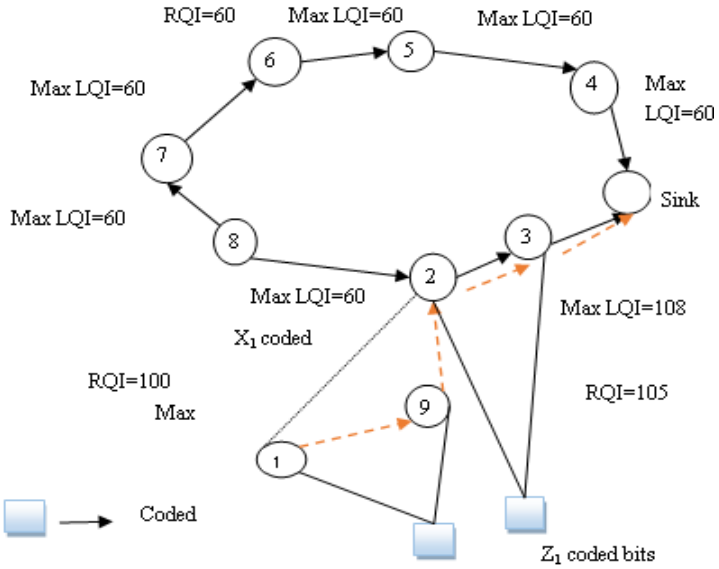

Figure 1: Proposed DXNC Network Coding for Reliable Communication

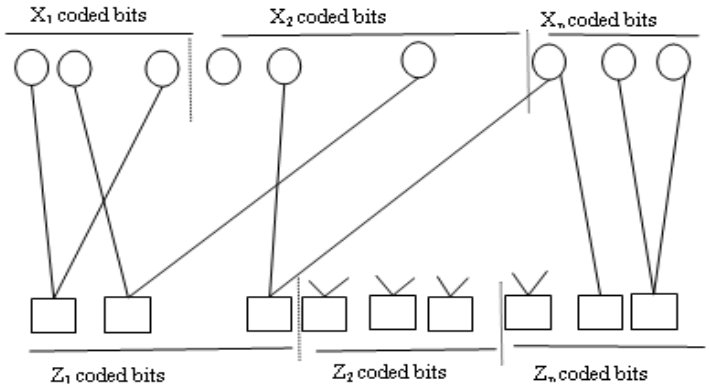

Figure 2: Bipartite Graph for DXNC Scheme with H= 2

SIMULATION RESULTS

Simulation Model and Parameters

The Network Simulator (NS2) [15], is used to simulate the proposed architecture. In the simulation, the mobile

nodes move in a 50 meter x 50 meter region for 50 seconds of simulation time. All nodes have the same transmission range of 250 meters. The simulated traffic is Constant Bit Rate (CBR).

Table 1: Simulation Settings and Parameters

No. of Nodes	20,40,60,80 and 100
Area Size	50 X 50
MAC	IEEE 802.11
Transmission Range	250m
Simulation Time	50 sec
Traffic Source	CBR
Packet Size	512
Rate	50,100,150,200 and 250Kb
Routing Protocol	RC
Simulation Time	50sec

Performance Metrics

The proposed Reliable Communication in WBAN (RC) is compared with the Channel Quality Based Routing (CQBR) technique [10]. The performance is evaluated mainly, according to the following metrics.

- **Delay:** It is the amount of time taken by the nodes to transmit the data packets.
- **Packet Drop:** It refers the average number of packets dropped during the transmission.
- **Packet Delivery Ratio:** It is the ratio between the number of packets received and the number of packets sent.

Results: Based on Nodes

In our experiment we vary the number of nodes as 20,40,60,80 and 100.

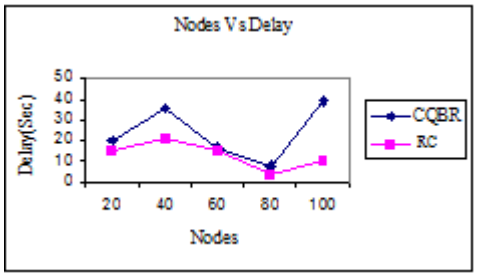

Figure 3: Nodes vs Delay

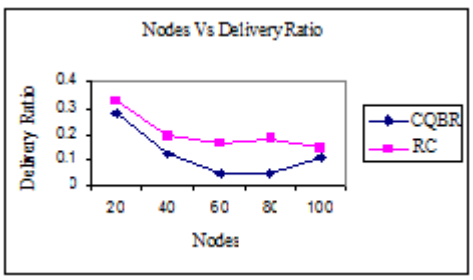

Figure 4: Nodes vs Delivery Ratio

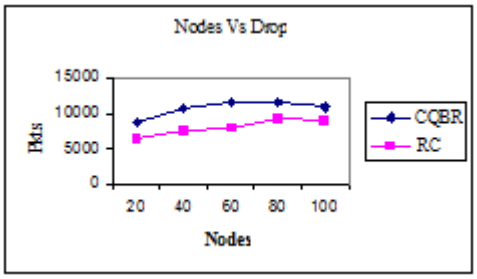

Figure 5: Nodes vs Drop

Figure 3 shows the delay of CQBR and RC techniques for different number of nodes scenario. We can conclude that the delay of our proposed RC approach has 41% of less than CQBR approach.

Figure 4 shows the delivery ratio of CQBR and RC techniques for different number of nodes scenario. We can conclude that the delivery ratio of our proposed RC approach has 45% of higher than CQBR approach.

Figure 5 shows the drop of CQBR and RC techniques for different number of nodes scenario. We can conclude that the drop of our proposed RC approach has 25% of less than CQBR approach.

CONCLUSIONS

This paper proposed network coding technique adopted for reliable communication for patient monitoring in mobile WBAN. A Demodulate and Forward XOR Network Coding Scheme is used to generate an efficient network code to increase the reliability during communication.

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